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Blood Group Detection using Image Processing MATLAB

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Abstract: Blood grouping is one of the common and most essentiality for many of the major healthcare applications. Traditional way to determine the blood group involve human such as trained medical professionals which generally lead to human error. One of the solutions to overcome this issue is to automate and digitize this method. Image processing and computer vision techniques can be used for this purpose. Therefore, in this paper, we investigate the blood group detection using image processing techniques. For this purpose, experiment starts by taking images of sample blood slide as input and convert it into gray scale followed by binarization and canny edge detection. Finally, it decided the agglutination by counting detected edges. Performance of method is tested on real- time blood sample dataset. Experimental results show the accuracy of proposed method is comparable to real- time test.
Keywords: Image Processing, Binarization, Canny Edge, Blood Group

I. INTRODUCTION

According to WHO, more than 1.35 million individual loses their life in road accident globally [1]. In most of the road accidents, due to injury victim loses blood and blood transfusion becomes a need of the hour. In such situations, it is necessary to find the blood group of victims so that a matching blood donor can be find. In addition to this, there are many situations where blood typing is needed such as veterinary care centers, during war at battle field, healthcare applications, crime/forensic sites etc. Most importantly, in a rural area of under developing countries, it becomes difficult to find the blood group of a victim if trained healthcare professionals are not available. Therefore, determination of blood type is one of the most common requirements in daily life. Not only blood group, but blood type with accurate information is also required in many emergency situations. The traditional way of blood type detection required trained human professional which is a bit slow and may lead to human error. Since these human mistakes might translate into catastrophic effects, being one of the most prominent causes of fatal blood transfusions is necessary to automate the method of these tests. However, in real time scenarios, it is necessary to find the blood group quickly so that a better treatment can be guaranteed. Therefore, it is necessary to automate these tests. Recently, advances in image processing and computer vision techniques are getting attention of the researchers to assess the blood group information. [2-3]. Different image processing algorithms such as image segmentation, canny edge detection is used to analyze the texture information, shape and size features from the image samples [4-5]. In slide test, one drop of reagent is mixed with a drop of blood sample and result interpreted according to the occurrence or not of agglutination. Therefore, blood type of patient is decided based on combination of occurrence and non-occurrence of the agglutination. Therefore, blood sample test based on image processing first collects image of blood samples collected after slide test to find agglutination.

A. Types of Blood

Based on presence/absence of antigen such as glycoproteins, proteins etc., on the surface of red blood cell, a blood classification is made. Generally, blood group can be classified as:

1) ABO Blood
2) Rhesus Blood

In blood transfusion, ABO blood system is considered as most important blood group. It consists of antigen A and antigen B. Based on the presence of antigen A and antigen B, the blood group further can be classified in the following four class

a) Group A
b) Group B
c) Group AB
d) Group O

Where, group A has only antigen A in the RBC, group B has only B antigen. Person who has both types of antigens have group AB while group O has neither A antigen nor B antigen hence considered as universal recipient.

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II. LITERATURE REVIEW

Blood is a key constituent in the human body, acting as a key connective tissue that maintains a number of the key ingredients, such as oxygen and different nutrients, in circulation. Therefore, method to knowing the blood type, RBC/CBC count is very important [6]. plate test and the tube test are two most popular traditional means of identification of blood group [7]. These two tests are done in the observation of human which may lead to error [8]. In addition to that, there are also a micro plate testing, but this required highly trained and skilled person along with a special type of equipment to carry out this test. Therefore, this procedure is comparatively costly and may not be affordable to patient. Ro reduce the cost as well as improve the efficiency of blood type detection system, many researchers used preferred image processing techniques. In [9], Ravindran et al. proposed a blood group detection system using image processing algorithm. In their study, the used five techniques such as pre-processing of image samples, where they converted colour to grayscale. In the next step they applied thresholding and followed by morphological operation. Finally, blood group detection was done with the help of quantification. In the result, it is reported that, the method devised demonstrates that the agglutination process is effective and effective and properly detects the patient's blood type. Ferraz et al. [10] automated the blood group detection technique using image processing algorithm. For this purpose, they developed a custom application which was used to analyse captured image of blood sample. In [11], Dougherty et al. studied the application of image processing in medical. A similar effort is made by Jahne et al. in [12] [13]. Considering the importance of blood group determination, in [14], Alexandar et al. highlighted the challenges and issues with traditional way of blood group detection. They also pointed out the human errors that may worsen the victim health situation. In their study, the tried to automate the blood group detection process using integrated Microfluidic Device. The proposed method actually detects the Agglutinated and non-agglutinated blood cells. Anthony et al. [15] proposed a novel for blood typing u sing ultraviolet/visible spectroscopy. This method also quantifies the agglutination of RBC. The aim of this research is to simplify the detection technique by substituting the spectrum imaging of the diode array spectrophotometer with a discrete sequence of LED and photodiode pairs within the wavelength range of interest, in the forward scattering direction. A similar effort to study the blood typing following Spectrophotometric Approach is proposed by Lambert et al. [16].

III. PROPOSED METHOD

The proposed method of blood typing is shown in Figure 1. Figure shows the configuration of the detection algorithm and approach. It illuminates the digital calculation method for an image's edge detection. We use gray scale conversion to gray scale and binary inversion in the picture to obtain the necessary little bit output picture first in our suggested model. Then we employ Caddy Edge detection technique after the completion of the segmentation step to find image clotting edges. Finally, we use MATLAB to develop the efficient technique Canny Edge Detection.

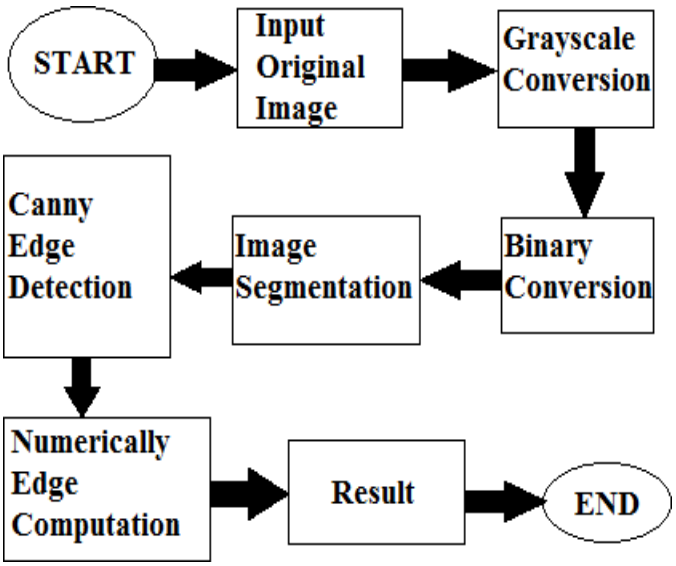


Figure 1: Block diagram of proposed method.

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A. Gray Scale conversion

The RGB picture is based on the RGB Color Model, which combines a wide variety of colors using red, green and blue photons [17]. These additive primary colors give the name of the model. This color model's major strategy is to show and represent the pictures in the electronic system. This is a device-based color model in which various devices may detect a particular RGB value via color components and characteristics and the reaction to specific levels R, G and B. We must estimate how much each red, green and blue is contained to create the numerical representation of the RGB color model. The color expression as RGB triplets (r, g, b) can range from zero to the maximum value of each color compound. If all the color components are at zero, the results are black and the highest value, the result is the brightest white [18]. Convert from our real data image as seen in Figure 3.4 to a grayscale of any color picture.

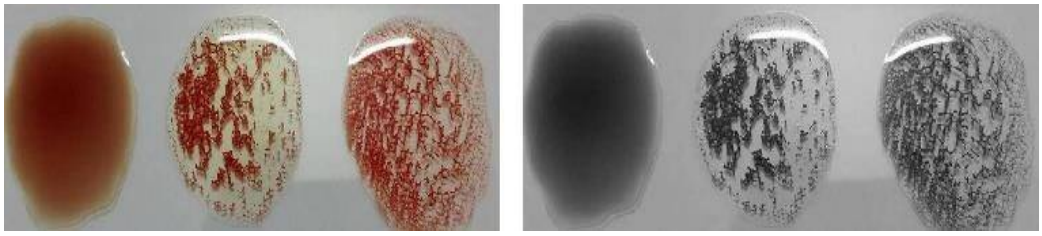


Figure 1: (a) input RGB image, (b) Grayscale conversion of datasets output image.

B. Binary Conversion

A binary picture is a digital picture with just two values per pixel. The histogram of the binary image conversion is determined. Histogram is a 1- [18], [19].

$$\bar{X} = (X1+X2+X3+\cdots+XNN)/N = \Sigma X/N \quad \text{(i)}$$

$$\sigma = \sqrt{\sigma 2} = \sqrt{(\Sigma(x-x)2 / N)} \quad \text{(ii)}$$

Dimensional matrix used in frequency distributions

Where,

Represents the sample mean which to describe pixel intensity. Statistical parameter is a value used as a segmentation result for defining the number of images. For determination of statistical parameters, we employ the mean and standard deviation as shown in Equation (i) and (ii) represents standard deviation and represents individual values, and Where N represents the total number of values in the sample. Figure 2 shows the result of binarization process.

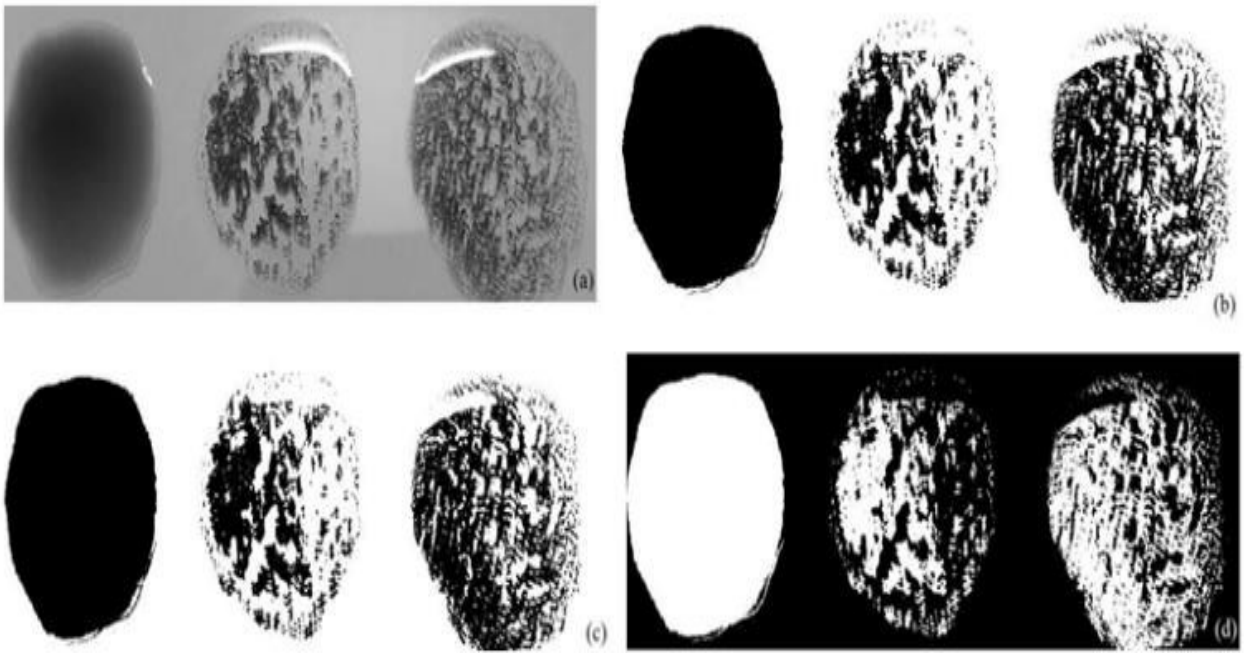


Figure 2: Binary Inversion of the images having blood samples

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C. Segmentation

Segmentation is the technique by which a digital picture is divided into many segments in pixel sets. The segmentation of the image usually is based on two fundamental intensity values; the number of columns adds n. The elements in the representation matrix are each referred to as a pixel. In Figure 3, the image is segmented into three parts Group A, Group B and Rh factor using the segmentation function

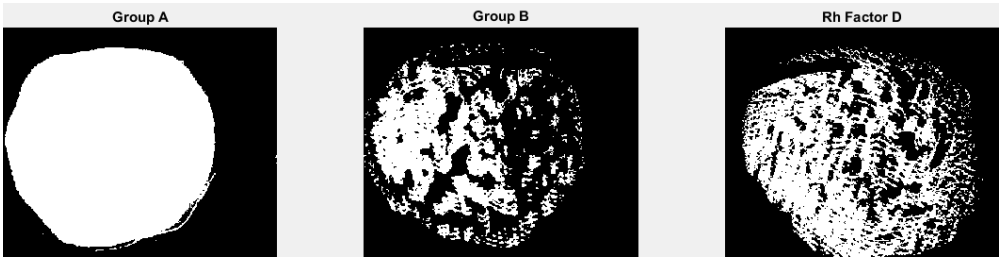


Figure 3. Segmentation of the blood image in section (a) Group A, section (b) Group B, in section, (c) Rh-factor.

D. Canny Edge Detection

Canny method is an image processing edge detection methodology that works by identifying brightness discontinuities [18]. Canny edge detection is a technique for multilevel detection that can detect edges from the pixel image. Smooth the image with a Gaussian filter to reduce noise and unwanted details and textures through the equations as listed below.

$$g(m, n) = (m, n) * f(m, n) \quad \text{(iii)}$$

$$G\sigma = 1/\sqrt{2\pi\sigma^2} \exp(-m^2 + n^2 2\sigma^2) \quad \text{(iv)}$$

Compute gradient (m, n) of using any of the gradient operations to calculate

$$(n, n) = \sqrt{(Gm2(m,n) + Gn2(m,n))} \quad \text{(v)}$$

$$(m, n) = \tan^{-1}[gn(m,n)/gm(m,n)] \quad \text{(vi)}$$

And to calculate the threshold value the equation is

$$MT(m,n) = \{M(m,n), \quad if M(m,n) > T$$

$$0, \quad otherwise \quad \text{(vii)}$$

where edges elements are denoted by T, Non- maxima pixels in the edges MT calculated above to thin the edge ridges so non-zero of M (m, n) is greater than its two neighbors along the gradient direction (m, n).

Finally, we have concluded with counting the existing edges after detection from the image, which is given in Fig 3.7 and decided on the numeric values as followed in

Group A: 18

Group B: 397

Rh factor: 492

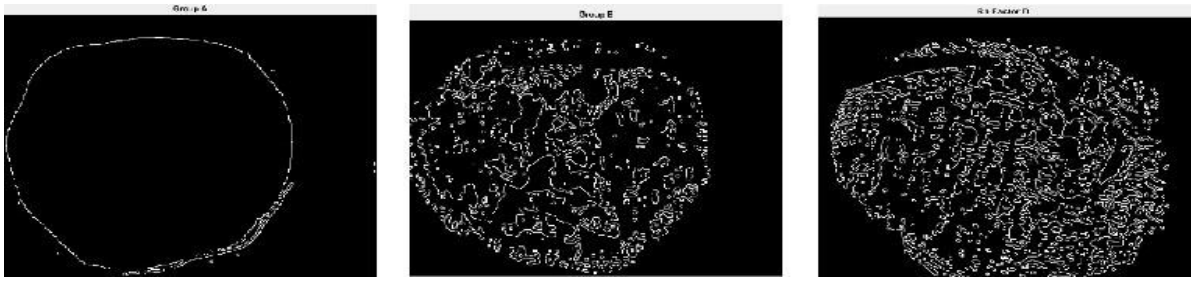


Fig 3.7 Application of Canny edge detection technic on image in figure (a) for Group A, Group B for (b) and (c) for Rh-factor.
conglomeration when combined with antigens using

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IV. RESULT ANALYSIS

A blood group is detected in two components. One component is the identification of what group is like A, B or O, and the other half is positive or negative type detection. Both are performed using one diaphragm. We can identify blood sample our proposed approach. When agglutination happens, the present sample detects this sort of blood group.

If the portion A of the slide has agglutination and the part B does not aggregate the sample blood group detected is Group A. Likewise, we conclude that the blood sample will be group B if Part A has no agglutination and Part B contains agglutination.

However, if there is no clumping in either portion, then the blood type detects are group O, and if both part A and part B have been clumped, then the group detected is AB.

We concentrate on the Rh factor portion to check whether or not blood is positive. When there is a clumping of the Rh factor element of the blood group it is positive, and when there is no clumping of the blood group it is negative.

All kind and pattern of agglutination of blood groups are listed in Table 1. The blood bonding can be successfully detected by our suggested technique. The number of counted image edges is used to detect the blood group. We have taken the total edges for Group A, Group B and Rh accordingly after applying the image processing procedures described above. When the number of borders on the image is extremely large, agglutination occurs and if the number of edges is low, the absence of agglutination may be presumed. We determined that agglutination takes place on more than 32 edges of a given group based on the analyzes performed on 100 blood samples. We counted edges for a number of photographs with our data set. The number of edges of 8 different images are shown in Table 2.

Table 1: Agglutination Table

Group A	Group B	Rh Factor	Result
Not Agglutinated	Not Agglutinated	Not Agglutinated	O-
Not Agglutinated	Not Agglutinated	Agglutinated	O+
Not Agglutinated	Agglutinated	Not Agglutinated	B-
Not Agglutinated	Agglutinated	Agglutinated	B+
Agglutinated	Not Agglutinated	Not Agglutinated	A-
Agglutinated	Not Agglutinated	Agglutinated	A+
Agglutinated	Agglutinated	Not Agglutinated	AB-
Agglutinated	Agglutinated	Agglutinated	AB+

Table 2: Number of counted edges for A, B, Rh from eight samples of bloods from datasheets

Sample No	Number of edges in part A	Number of edges in part B	Number of edges in part Rh factor
1	166	2	14
2	232	248	5
3	18	397	492
4	2	6	128
5	3	1	1
6	4	144	4
7	155	352	343
8	250	17	121

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We have the information provided in Table 2 from our suggested model. We make further computations using this information from Table 2 and results are shown in Table 3.

Let us declare three variables N_A, N_B and N_{RH} for part- A, part-B and part of Rh-factor respectively. Were, N_A= number of detected edges in part A

N_B= number of detected edges in part B

N_{RH}= number of detected edges in part of Rh-factor Now we're going to verify whether $N_A > 32$. If the assertion is true, agglutination occurs and we put N_A=1 value. Or if the declaration is wrong then there is no agglutination and we put $N_A = 0$. We'll check again whether $N_B > 32$. If the declaration is true, agglutination has taken place and we set $N_B = 1$. Or if the sentence is wrong then there was no agglutination and we put $N_B = 0$ value.

Finally, we verify $N_{RH} > 32$. Last but not least. If the declaration is valid, agglutination has occurred and we set $N_{RH} = 1$ value.

Or if the assertion is wrong then there was no agglutination and we set the $N_{RH} = 0$.

Considering,

1 = “agglutinated”

0 = “Not agglutinated”

The results are now compared to Table1 data from the data we acquire from here, and from Table1 pattern we obtain the result.

The number of edges of section A in the sample No 1, is 166, so in this case ($N_A = 166$) > 32. The blood sample was agglutinated here for Type A. Likewise, Part B is 2 with a number of edges. The blood sample was consequently not agglutinated here ($N_B = 2$) < 32. The detected edge is 14, as is the Rh factor. ($N_{RH} = 14$) < 32, meaning that blood samples are not agglutinated. So, the blood type of A- was identified. By merging all results, we complete the exact blood group of the blood input sample. All other samples have been equally measured. Table 4 shows that the results of the suggested approach have corresponded to the results in real time. All calculations for the Table 2 sample have been displayed here. In fact, we have tested 100 photographs of our process and always matched the results with the real-time outcome. For each type of blood group, we have a graph of the values of the discovered edges. So, we get eight diagrams for eight blood group kinds. Each type of blood group has its own shape, however the form of the same groups of blood is varied.

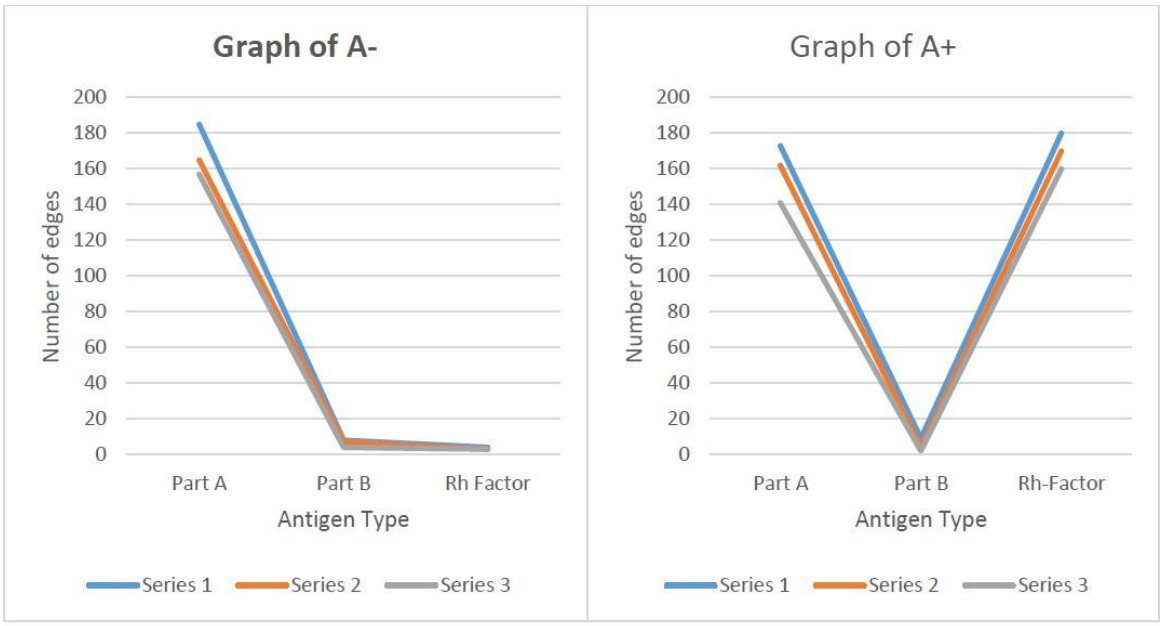
Table 3: Result of the sample mention in Table 2

Sample No	Value of N_A	Value of N_B	Value of N_{RH}	Result
1	1	0	0	A-
2	1	1	0	AB-
3	0	1	1	B+
4	0	0	1	O+
5	0	0	0	O-
6	0	1	0	B-
7	1	1	1	AB+
8	1	0	1	A+

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Table 4: Accuracy Table

Sample No	Real Time Result	Proposed model's Result	Result Matched
1	A-	A-	Yes
2	AB-	AB-	Yes
3	B+	B+	Yes
4	O+	O+	Yes
5	O-	O-	Yes
6	B-	B-	Yes
7	AB+	AB+	Yes
8	A+	A+	Yes



(a) (b)

Figure : (a) Graph of B- blood group, (b) Graph of B+ blood group



(a) (b)

Fig 4. 1 (a) Graph of AB- blood group, (b) Graph of AB+ blood group

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A. Comparing with Other Models

Some existing blood group detection models are available. A. Ferraz suggested that he should take the image threshold value and utilize the quantification approach. And to identify agglutination, it computed some standard deviation values. For the agglutination, he set the standard deviation at 16. If the default deviation is above 16 then agglutination has taken place and if the standard deviation value does not exceed 16, agglutination has not taken place [4, 9]. However, several others in the same form proposed that the default number should be 20 instead of 16[11]. They both were right in the dataset, but if we exchange and then apply the dataset, the outcome will be erroneous. Neither of the researchers' models were 100% correct. In every type of data collection, detection of the blood group should be correct. Our approach is not the same as other methods. We tried to work for an alternative strategy, rather than computing a minimum, maximum, medium, and standard deviation. It forms several little edges when the blood agglutinates.

V. CONCLUSION

This paper proposes a novel and efficient digitally blood group identification algorithm, which is applied to images from hospitals. Sets of images are acquired by mobile devices and then processed by methods and algorithms of image processing. By analysing the data, we calculated blood type of the sample that took real life image. We counted the edges for each image. The experimental results and the comparison with the results of the real-time diagnosis show a promising process of efficient performance.

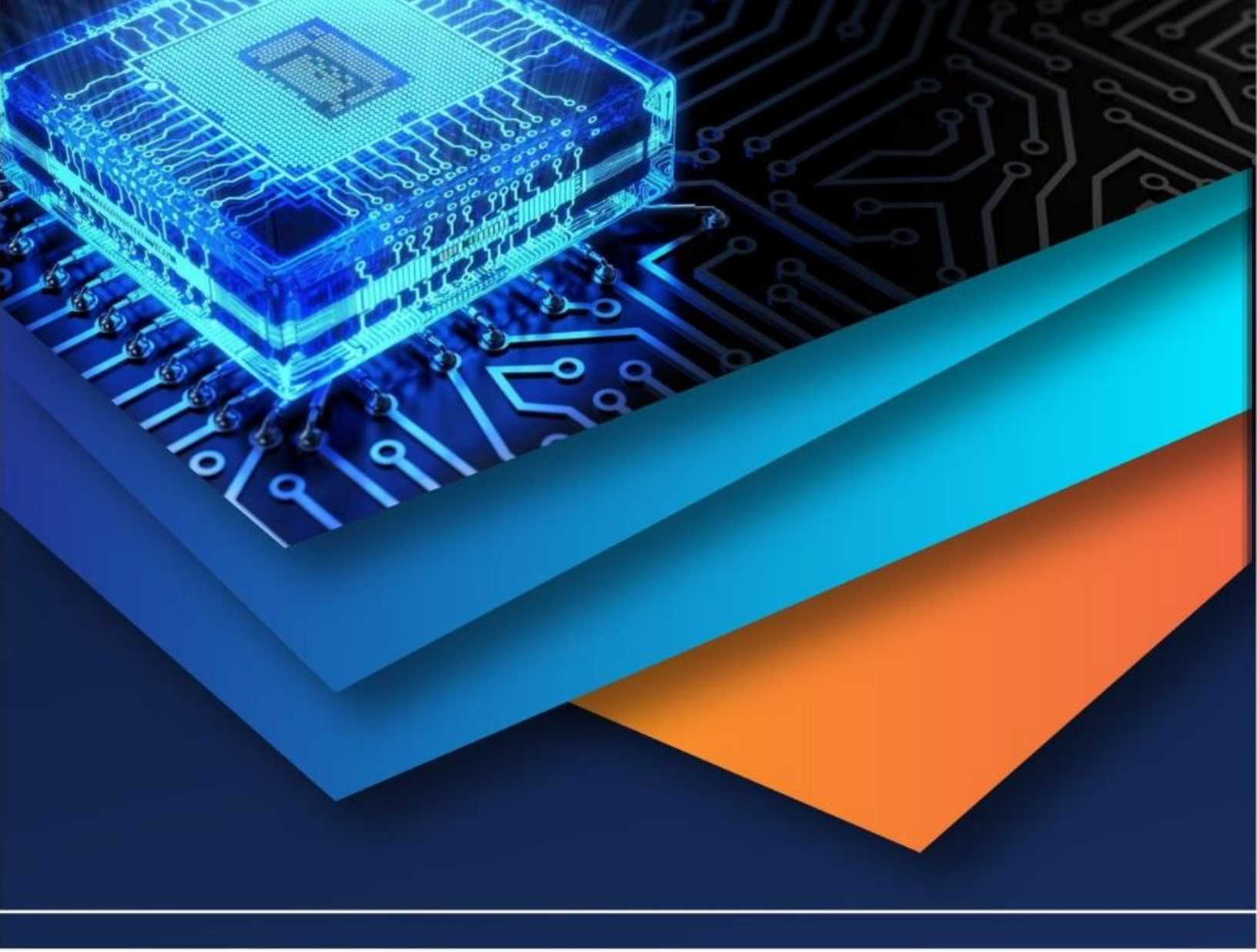
A novel, efficient model of blood group detection utilizing imaging methods will be presented in this article. We've been working on a real-time dataset of 100 samples of blood. Three blood samples were divided and Canny's edge detection method was utilized thereafter. Then we tallied the edges observed in order to identify the sample blood group. The results of our experiments and the comparison with the results for real-time diagnostics show potential efficiency processes.

We will try to detect microscopic pictures from a blood group using a form and pattern approach to identify a certain antibody in the blood cell that responds with antigen and does not require any blood group pathology tests. Our blood group identification approach is practicable for ordinary individuals. Diagnostic facilities can gather pictures and produce reliable findings for data collection.

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